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ABSTRACT

The task of reorganizing the elementary schools of the Soviet Union has provided the occasion for the assessment of programed instruction methods. Though programed texts have been widely used in other countries, the Soviet Union is committed to a different set of educational values, including the use of national teachers, a system that develops each student to his highest potential, and to the development of self-control. Not all the principles of programed instruction address these issues, but programed instruction can be of some value to teachers attending to the individual problems of students. An example of a program to teach subtraction of numbers less than 1,000 is included. (EMH)

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EXPERIENCE WITH PROGRAMMED INSTRUCTION IN ELEMENTARY SCHOOL

by N. F. Kopeleva

- USSR -

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EXPERIENCE WITH PROGRAMMED INSTRUCTION IN ELEMENTARY SCHOOL

- USSR -

/Following is a translation of an article by N.F. Kopeleva, Assistant in the Department of Methods of Elementary Education of the Moscow State Pedagogical Institute imeni V.I. Lenin, in the Russian-language periodical Nachal'naya Shkola (Elementary School), Vol 31, No 10, 1963, pp 50-58./

The task of reorganizing the school induces Soviet teachers to use those forms of organizing the children's educational activity which will promote the skill of independently obtaining knowledge and using it in solving various educational and practical problems. Thus, the question about the possibility and expediency of using, in primary classes in schools, some ideas on which so-called programmed instruction is based, is not devoid of interest.

One of the main peculiarities of such instruction is that the educational material is broken up, on the basis of logical analysis, into small parts, the sizes of which are determined taking into account general-pedagogical considerations. These parts are arranged in a strictly logical sequence, so that mastering of each such part ensures the possibility for the school children to examine the nest independently. Thus, the pupil progresses step by step in the learning of new material. This is accomplished because the material of each part is given with all instructions necessary for independent learning.

Constructing text-books on this basis for programmed instruction and "programs" for teaching machines, this principle is used abroad, in particular in the USA., with the purpose of "mechanization" of the process of instruction. The instruction with "programmed" text books or using teaching machines reduces the teacher into an organizer and inspector of students' activities. The process of instruction becomes a process of self-instruction.

The Soviet school will never start on the path of rejecting the purposefulness of the teacher's educational-training influence on the children, on the path of replacing the teacher with some kind of "intelligent" machines.

In N.S. Krushchev's statement: "The national teacher is the main support of the Party in the struggle for the nation's cultural development, the Party's nearest assistant in educating the new man, "-- citing L.F. Il'ichev in his report at the June Plenum of the Central Committee CPSU, he emphasized the teacher's role with especial force.

Western propaganda sees, one of the chief values of programmed instruction, in that the instruction accomplished at this individualized pace makes it possible to increase the speed of studying the material by separate students.

The Soviet school undertakes the task of maximum thorough development of each student, approaching individual instruction differently. We strive not so much to speed up the process of acquiring a certain amount of knowledge, skills, and habits by separate students, as to extend the knowledge, develop creative abilities, initiative, and activity, considering each student's individual possibilities.

Great attention is paid to realizing immediate self-control with programmed instruction. It is realized in different ways. One of the most practiced forms of self-control when learning from a "programmed" text book is that when solving a problem the student has an answer to it in front of him, sometimes given on the same line with the problem. It is supposed that the student will look at the answer only after the problem is solved.

It can be said with surety that such a form is unacceptable for elementary schools because it requires a high level of consciousness in learning, and self-discipline unattainable for small children, still must be taught how to learn. One of the important components of this ability to learn is the ability and habit of self-control in the process of solving any problem. Soviet teachers have accumulated a great deal of experience in regard to this, and Soviet techniques know of different methodical ways of assisting the development of this ability. It is clear that the generally accepted form of self-control during programmed instruction does not solve this problem.

Thus we see that not all the principles of programmed instruction answer the problem faced by our elementary schools. At the same time, the processing of educational material which is the basis of composing programmed textbooks is an important and useful matter. It brings clarity and accuracy to the understanding of the logical structure of the material; makes it possible to plan a strict sequence of its component parts; demands a thorough selection of earlier learned material, which it is necessary to remember when preparing to grasp the new; offers a choice of more rational methods of introducing new material and of organizing exercises, which are directed at consolidating and strengthening the earlier-acquired knowledge.

If it was really possible in practice to construct materials answering all these demands, it is easy to imagine how useful they would be to the teacher. Such materials are to be regarded not as a self-instructor for the pupil but as an aid for the teacher, which he can use at his own discretion. In some cases, he uses them as methodical instructions for examining any problem, in others, as auxiliary educational material for the independent work of the children. These materials can also be used for individual work with separate pupils when filling in the gaps in their knowledge, or as additional tasks directed at strengthening knowledge on any subject. With this in mind, they can be used to organize independent work on a lesson, considering the individual differences of pupils. The question as to what importance should be accorded to such materials in learning various subjects, in what form they should be used, can be solved only in practice, taking into consideration the specific conditions.

Without solving all these problems, we made an attempt, in an experimental way, to develop similar material on several subjects for the class III program. Thus our chief attention was concentrated on the selection of previously learned material, necessary for grasping the new material, and on selecting those tasks which would provide the possibility of organizing independent work when getting acquainted with new material.

Below we introduce as an example the materials related to the subject of "Written subtraction in limits of 1000".

Each part is marked by a Roman numeral. The assignments are designated by an Arabic numeral in parentheses. We organized the self-control thus. After performing the task of one part in the copy-book, the pupil showed it to the teacher. The latter, convinced after a glance (for time economy) that all problems of this part are performed, gave the pupil a card with answers to this part, numbered

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according to the numbering of the assignments. The pupil checked his answers according to the card.

Subtraction of Three-digit Numbers

The example 560 - 320 can be solved thus: first, from 500 take away 300, obtaining 200, then from 60 take away 20 obtaining 40, then adding 200 and 40 we obtain 240. It is more correct to say "subtract", and not "take away". Therefore, instead of saying: "From the number 560 take away the number 320", we will say: "From the number 560 subtract the number 320". From now on we will say "subtract" when doing subtractions.

1. Read correctly and solve in your copy-book the examples 780 - 250 (reading thus: from the number 780 subtract the number 250); 430 - 210; 660 - 450, 570 - 320.

Doing the problem 570 - 320, from the number 570 you subtracted 320 and obtained 250.

Read and remember what the numbers are called when subtracting.

The number from which we subtract is called the minuend (in our example, 570 is the minuend).

The number which is subtracted is called the subtrahend (320 is the subtrahend).

The number which we obtain after subtraction is called the difference or remainder (250 is the difference, or remainder). The sign for subtraction is the minus.

1. Find the difference between 830 and 110. Find the sum of the same numbers.

2. The minuend is 650, the subtrahend 240. Find the remainder. The first item is 420, the second is 350. Find the sum.

III

Review how to find the difference between the numbers 563 and 322, e.g. how to subtract 322 from 563. 563 = 5 hundreds, 6 tens, 3 units; 322 = 3 hundreds, 2 tens, 2 units.

Let us subtract starting from the units: 3 units - 2 units = 1 unit.

Then subtract the tens: 6 tens - 2 tens = 4 tens.

Now subtract the hundreds: 5 hundreds - 3 hundreds = 2 hundreds.

We come up with the number in which there are 2 hundreds 4 tens and one unit, e.g. 241.

IV

Subtraction of three-digit numbers is easier if we write them in a column one under the other, similar to adding of three-digit numbers.

1. Review the addition of three-digit numbers. Do the problem: 563 + 322. Write the numbers in a column. We write the numbers in subtraction in the same way. One has to remember that the units of the subtrahend are written below the units of the minuend, the tens below tens, the hundreds below hundreds.

For example, if from the number 563, the number 322 is to be subtracted, the numbers are written in a column thus: 563
322
between the numbers on the left is the sign of subtraction, and a line is passed under the second number: 563
-322

Subtraction goes thus: first subtract the units 3 units - 2 units = one unit; we write one unit below the line under the units; then we subtract the tens 6 tens - 2 tens = 4 tens; the tens are written under the tens; now we subtract the hundreds 5 hundreds - 3 hundreds = 2 hundreds; 2 hundred is written under the hundreds.

We obtain such asn entry 563
-322
241

V

1. Do the examples. Start subtraction with the units.

469	754	859	528
-246	-623	-221	-312

2. Remember ! When doing addition and subtraction in a column the units go under the units, tens under tens, hundreds under hundreds.

Do the examples, writing the numbers in a column:
767 - 655 697 - 243 378 - 153 234 + 521

3. Read the problem carefully. We have 938 museums in our country, in pre-revolutionary times there were 725 less museums. How many museums were there in pre-revolutionary times?

Write in the copy-book, on the first line, how many museums are there at present. On the second line write how many less there were in pre-revolutionary times. Consider

what action is necessary to solve this problem. Solve it.

VI

1. Write 3 two-digit numbers and 3 three-digit numbers.

Remember how you write them when subtracting in a column.

See how to write such a problem in a column: 486 - 53.

$$\begin{array}{r} 486 \\ -53 \\ \hline \end{array}$$

Think why under the number 4 (hundred) nothing is written.

Let us do this example:

$$\begin{array}{r} 486 \\ -53 \\ \hline 433 \end{array}$$

2. Write these examples correctly in a column and solve them.

637 - 25 997 - 64 523 + 235
127 + 62 829 - 18 764 - 123

3. Read the problem carefully. 465 bushes of seedlings were delivered to the florists. 53 bushes were sold in the morning. How many bushes of seedlings were left at the florists? Solve the problem.

VII

There are 6 apples on a plate. How many apples will be left if you take 6 apples?

$$6 - 6 = 0$$

There are 6 apples on a plate. How many will be left if you do not take any?

$$6 - 0 = 6$$

Sove the problems.

1. The minuend is 5, the subtrahend is 5. Find the difference.

The first addend is 5, the second addend is 5. Find the sum.

The first addend is 5, the second addend is 0. Find the sum.

The minuend is 5, the subtrahend is 0. Find the difference.

The minuend is 0, the subtrahend is 0. Find the difference.

The first addend is 0, the second addend is 0. Find the sum.

VIII

1. Solve the examples.

789 - 660	544 - 102	679 - 59
483 - 181	403 + 306	907 - 603
652 - 40	561 + 208	608 - 308

2. Read this problem carefully. There are 605 pioneers in one school, in another there are 405 pioneers. How many more pioneers are there in the first school than in the second?

Remember, by what action it is possible to find how much greater one number is than the other. Solve the problem.

IX

1. Devise and solve in the copy-book 3 problems on subtraction in which the minuend is ten and the subtrahend is any one-digit number.

See how to do such an example:

$$\begin{array}{r} 540 \\ -126 \\ \hline \end{array}$$

540 = 5 hundreds, 4 tens, 0 units

126 = one hundred, 2 tens, 6 units

At first we subtract the units, but 6 cannot be subtracted from 0. In this case we do thus: from 4 tens (of number 540) one ten is taken; so that we do not forget about it, we put a dot over the number 4. In one ten there are ten units, thus the ten is replaced by ten units and 6 units are subtracted from ten units: 10 units - 6 units = 4 units; 4 units are written under the units below the line.

$$\begin{array}{r} 540 \\ -126 \\ \hline 4 \end{array}$$

Now subtract the tens. We see a dot over number 4 (4 tens of number 540). This dot is a signal for memory: it shows that here are 3 tens instead of 4 tens because we have taken one ten for subtracting the units. 3 tens - 2 tens = one ten.

$$\begin{array}{r} \dot{5}40 \\ -126 \\ \hline 14 \end{array}$$

Subtract the hundreds: 5 hundreds - one hundred = 4 hundreds.

$$\begin{array}{r} 540 \\ -126 \\ \hline 414 \end{array}$$

Think about why, in subtracting the tens, we obtained one ten.

2. Do the examples.

750 - 243	670 - 229	530 - 415
890 - 73	175 + 415	490 - 65

3. Read the problem carefully. "The Little Octobrists of one school promised to make 340 toys for the nursery school. After they made part of the toys, 118 toys were left to be made. How many toys have the Little Octobrists already made?

Write down how many toys were left to be made. Write down, how many were supposed to be made by the Little Octobrists. Solve the problem.

X

1. One ten 5 units = 15

Following the example write the make-up of numbers in which:

one ten one unit =	one ten 2 units =
one ten 7 units =	one ten 6 units =

2. Solve the examples and write them in a copy-book in this order: the first must be the example with the minimum result, then the results which are greater, and the last one with the greatest result.

12 - 7	15 - 6	12 - 8
17 - 9	11 - 4	11 - 9

XI

See how to do this example:

876 876 = 8 hundreds 7 tens 6 units
-528 528 = 5 hundreds 2 tens 8 units

First, the units are subtracted, but 8 units cannot be subtracted from 6 units because 8 is greater than 6. Therefore, from 7 tens take one ten. Over number 7 we put a dot. One ten and 6 units are 16 units. 16 units - 8 units = 8 units

$$\begin{array}{r} \overset{\cdot}{8}76 \\ -528 \\ \hline 8 \end{array}$$

Subtract the tens. Over number 7 there is a dot, which shows that there are 6 tens and not 7 tens, for we have taken one ten for subtraction of the units.
6 tens - 2 tens = 4 tens

$$\begin{array}{r} \overset{\cdot}{8}76 \\ -528 \\ \hline 48 \end{array}$$

Subtract the hundreds. 8 hundreds - 5 hundreds = 3 hundreds

$$\begin{array}{r} 876 \\ -528 \\ \hline 348 \end{array}$$

1. Do the examples.

983 - 536	864 - 357	631 - 116
690 - 164	167 + 325	547 - 29
428 - 319	760 - 48	278 + 619

2. Read the problem. Our country had 139 television centers in 1958, but in 1962 there were 361 television centers. How many less television centers were there in 1958 compared to 1962?

By what action do we find out how much smaller one number is than the other?

Solve the problem.

XII

See how to do this example: $\begin{array}{r} 909 \\ -714 \\ \hline \end{array}$

Subtract the units: 9 units - 4 units = 5 units.

Subtract the tens, but from 0 we cannot subtract one ten. From 9 hundred take one hundred; in order to remember it, put a dot above the hundreds. In one hundred there are ten tens. Substitute the hundred with ten tens. From 10 tens we can subtract one ten. 10 tens - one ten = 9 tens.

Subtract the hundreds. Over number 9 (hundred) put a dot, which shows that instead of 9 hundreds there are 8 hundreds because one hundred was taken out to subtract the tens. 8 hundreds - 7 hundreds = one hundred.

$$\begin{array}{r} 909 \\ -714 \\ \hline 185 \end{array}$$

XIII

1. One hundred and 2 tens = 12 tens. Following the example write the make-up of numbers in which there are one hundred 2 tens; one hundred 9 tens; one hundred 3 tens; one hundred 7 tens; one hundred 5 tens.

See how to do such an example: $\begin{array}{r} 625 \\ -364 \\ \hline \end{array}$

Subtract the units: 5 units - 4 units = 1 unit

Subtract the tens, but 6 tens cannot be subtracted

from 2 tens.

From 6 hundreds take one hundred; one hundred and 2 tens is 12 tens; 12 tens - 6 tens = 6 tens

Subtract the hundreds. In the number 625 a dot over 6 shows that one hundred was taken, thus only 5 hundreds are left.

5 hundreds - 3 hundreds = 2 hundreds

$$\begin{array}{r} \dot{6}25 \\ -364 \\ \hline 261 \end{array}$$

2. Do the examples.

409 - 231	702 + 119	829 - 635
654 - 364	693 + 281	740 - 280
583 - 491	526 - 83	185 - 91
749 - 647	307 - 181	327 - 292

3. Read the problem carefully. 364 school children were resting in one camp, in another there were 80 school children less than in the first, and in the third there were 329 less than the sum of the first and second. How many school children were resting in the third camp?

Write on the first line in the copy-book what you know about the first camp. On the second line write all that is known about the second camp. On the third line, write all that is said about the third camp. Think about what you have to know to answer the main question of the problem.

What is known? What is unknown?

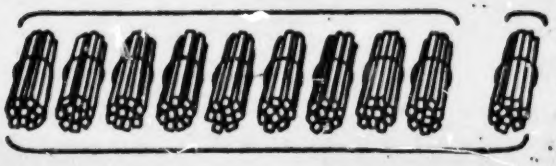
Solve the problem.

Parts XIV and XV are dedicated to exercises similar to examples of the type: 831 - 369

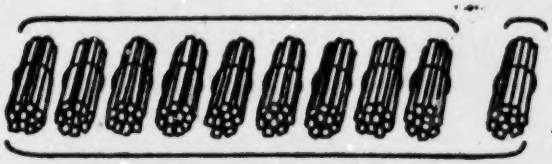
XVI

Carefully look over the pictures and the headings under them.

100 = 10 tens, or one hundred = 10 tens.



9 tens 1 ten
One hundred = 9 tens + one ten



9 tens 10 units
One hundred = 9 tens + 10 units

1. 500 is 5 hundreds; 5 hundreds = 4 hundreds + one hundred

5 hundreds = 4 hundreds + 9 tens + 10 units

Following this example, show the make-up of the numbers:

300 3 h. = 2 h. + one h. or 3 h. = 2 h. + 9 t. + 10 u.
800 8 h. = 7 h. + ... or 8 h. = 7 h. + ... + ...
200 2 h. = ... + ... or 3 h. = ... + ... + ...
600
900

/Transrators note: in the above example, h = hundreds, t = tens, u = units./

XVII

See how to do this problem:

500 500 = 5 hundreds 0 tens 0 units
-187 187 = one hundreds 8 tens 7 units

Subtract the units, but 7 cannot be subtracted from 0. We cannot take a ten from the tens because there is a 0. So from 5 hundreds we take one hundred and put a dot over number 5. In one hundred there are 9 tens and 10 units. 9 tens are left for tens and 10 units are taken for the units. Now let us subtract the units from 10 units.

10 units - 7 units = 3 units

$$\begin{array}{r} \dot{5}00 \\ -187 \\ \hline 13 \end{array}$$

Subtract the hundreds. In number 500 there are 5 hundreds, but there is a dot over number 5, which reminds us that one hundred was taken (9 tens for the tens and 10 units for the units), thus, 4 hundreds are left.

4 hundreds - one hundred = 3 hundreds

$$\begin{array}{r} \dot{5}00 \\ -187 \\ \hline 313 \end{array}$$

1000 = 10 hundreds = 9 hundreds + one hundred or 10 hundreds = 9 hundreds + 9 tens + 10 units.

1. Do the examples.

900 - 423	1000 - 525	703 - 294
259 + 541	800 - 351	807 - 458
500 - 497	605 + 195	400 - 35

2. Read the problem carefully. There are 504 theaters in our country at present, which is 327 more theaters compared to the number in pre-revolutionary times. How many theaters were there in our country in pre-revolutionary times?

Read this problem once again.

Solve the problem.

3. Read the problem carefully. 1000 magazines were delivered to a newsstand, 375 magazines were for children, the rest for adults. How many magazines were delivered to the stand for adults?

Write how many magazines were delivered in all.

Write how many magazines were delivered for children.

Solve the problem.

*

To check the knowledge of the pupils on this subject control works should be conducted. Here is an example of a control work consisting only of examples.

835 - 276	608 - 313
507 - 428	728 - 78
300 - 138	993 - 284
356 + 644	158 - 67
816 - 96	744 + 109

We think that every teacher should be prevented from making instruction according to this material into self-instruction.

The material presented above presumes that the teacher plays a guiding role in education.

An examination of the cards (conducted with individual pupils) showed that in most cases the best results may be obtained by combining the independent work of pupils with these cards and the teacher's explanation, and some difficult questions should be explained by the teacher, with the active participation of the pupils.

Thus, the material of cards IX, XI and especially XVI and XVII, as the most difficult, is more rationally explained by the teacher, along with extensive use of visual aids.

When learning the material of cards XII and XIII, similar to the material of cards, IX and XI after being explained by the teacher, it is possible to give the pupil a great deal of independence.

Cards V, VIII, X, XIV, XV may be worked out by the pupils independently, although this does not exclude instructions from the teacher.

According to the teacher's judgement, the remaining cards can be offered to the pupils for semi-independent or fully independent work.

The teacher may discuss the problems given in the cards in class if he sees such a necessity.

Our tests showed that material of this sort may help the teacher in teaching arithmetic. Their use may assist development of the pupils' skills for obtaining knowledge independently.

From the editors. In recent years more and more references have been made in the press to the new pedagogical system, known under the name of programmed instruction with the help of so-called teaching machines.

In the published article some principles of programmed instruction are explained briefly in the way the author understands it. In elementary school the instruction is without machines, it is a division of text materials into parts, arrangement of them in strict logical sequence; each part is well prepared by repeating that which will serve as a basis for the learning of new material and is presaged by a very definite task. Owing to all of this the pupil can absorb new material with greater independence.

All of these are positive features of the new system. They deserve our attention insofar as their utilization can, to a certain degree, serve the task of improving our system of teaching.

- END -

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